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HOW TO SAVE FUEL AT HOME

BY

J. F. BARKLEY

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HOW TO SAVE FUEL AT HOME[1]

by J. F. Barkley[2]

INTRODUCTION

War may cause a shortage of household fuel; schemes should therefore be devised for using less. It will be very helpful to the whole war program to have every householder use the least amount of fuel possible; this will be an exceedingly practical and effective way for each family to contribute to the national welfare.

There follows a discussion of various schemes for saving fuel, including the reasons why they are effective. To what extent any or all of these ways may be applied is an individual problem for each householder. It is believed that a better understanding of the reasons will result in better decisions and applications.

The problem of saving fuel is one of saving heat. The fuel itself, as such, is a very small part of the problem, as it is merely potential or stored heat. The temperature of the house is first raised to the desired point, and from then on only enough heat in the fuel (or enough fuel) is needed to make up for the heat losses from the house. Saving fuel, then, consists in preventing as much as possible these losses of heat from the house.

HEAT LOSSES

What are the heat losses and how can they be lessened?

1. Heat is lost when the fuel is not burned completely.

Unburned fuel is unreleased heat. It may leave the house as a loss in the ashes of solid fuels as particles of raw coal or coke; it may leave from the chimney as unburned gases, vapors, tars, smoke, and solid particles.

2. Heat is lost out the chimney, carried away by the hot gases coming from the furnace.

The quantity of heat lost varies with the quantity of the gases and their temperature.

Losses 1 and 2 may be lessened by better firing methods, better burner adjustments, cleaner and better-conditioned equipment. Perfect burning is obtained when the burnable part of the fuel is completely burned and no excess air is used. Excess air takes some of the heat produced by the burning and carries it out the chimney as a loss. It increases the amount of gases going out the chimney. As a practical matter, "perfect" burning is not obtained. A little excess air is required to prevent too great a loss from unburned fuel.

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1 The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7229."

2 Chief, Division of Solid Fuels Utilization for War, Bureau of Mines, U. S. Department of the Interior.

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The following suggestions[3] are offered for the hand fireman:

a. Select type and size of fuel carefully from those available. No definite rule can be given, as the selection depends on the equipment, the load, and the adaptability of the fireman. Where coal is used, it usually pays to experiment with a few different coals before making final selection. The coal costing the least in dollars per ton may not give least total yearly fuel cost, as more of it may be used. During wartime the exact fuel you would like may not be available.

b. Keep plenty of fuel in the furnace. Avoid thin fuel beds. The amount of fuel that is burned depends on the amount of air permitted to flow through it.

c. Keep air entering ashpit or furnace under control. Air going into the ashpit should be controlled by the ashpit damper. Air entering the furnace for the top of the fire should be controlled by the furnace-door damper. Additional control is obtained from the butterfly damper at the rear of the furnace and, if absolutely necessary, from the check damper. Automatic control based upon the temperature in the house is more satisfactory and efficient than hand control of dampers. Stop all uncontrolled leakage of air into heater, such as around the ashpit and furnace doors. Leaks may be discovered with a lighted match or, better, with a candle flame. Various furnace cements may be used to stop many kinds of leaks; steel wool or even a rag may be used to lessen leakage around grate shaker rod. Badly fitting doors or door dampers should be properly fitted by filing or be replaced.

d. Before shoveling fresh coal into the furnace, hoe up the fuel bed so that some hot, red fuel will remain on top of the bed after firing. This red fuel ignites unburned gases coming from the fuel bed.

e. Where there is much flaming at the top of the fuel bed, admit some air over the fire through the damper on the firing door. This air is needed to burn the gases at the top of the fuel bed.

f. Shake down the ashes gently and stop when any red particles fall into the ash pit. This usually leaves some ash on the grates, which is desirable to protect them.

g. Do not stir a fire with a poker. This is likely to throw ashes up into the burning part of the fire, where they will melt and form clinkers. If necessary to use the poker do so gently and do not use any deep "lifting-up" strokes.

h. Do not let the ashpit remain full of ashes. There should always be plenty of room over the ashes to permit entering air to reach all parts of the grate. This prevents the grate from heating and softening.

i. Keep breeching or furnace pipe to chimney free from obstructions and air leaks.

j. Keep chimney reasonably clean, free from obstructions and air leaks. This is particularly necessary where there is difficulty in obtaining enough draft. The top of the chimney should be higher than all roof points; this prevents downdrafts when the wind blows.

Automatic fuel-burning equipment should be adjusted by an expert service man. Ask him to check all possible air leaks into the furnace and heater. Study the fire after the

3 For more detailed instructions, see Barkley, J.F., Questions and Answers for the Home Fireman: Bureau of Mines, 1940, 34 pp.

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adjustments have been made, and also the gases coming from the top of the chimney. From time to time during the heating season look at the fire and the chimney to see if the original adjustments appear to be maintained. Regular service calls also serve as a check.

To keep the temperature of the gases that carry heat out the chimney reasonably low, all heat-absorbing surfaces of the heater must be kept as clean as possible. One cleaning a season is seldom enough except, possibly, where gas is used as a fuel. High loads on the heater necessarily cause more loss out the chimney. Do not force the burning any more than necessary.

During the off season, the entire heating equipment should be thoroughly repaired, cleaned, and oiled; leaks should be stopped and all parts adjusted.

The following table gives the percentage of heat in the fuel that goes into the house for the usual domestic heating equipment.

Over-all efficiencies

(Solid fuels listed are hand-fired)

	High	Low
Anthracite	70	50
Bituminous, Subbituminous	65	40
Lignite	53	40
Coke	70	50
Oil	75	50
Gas	80	55

The efficiency of the average household boiler and stoker may be estimated at 55 to 65 percent. The wide range for each fuel shows how greatly the heat loss varies with furnace operation and type of equipment. This loss is due largely to unburned fuel and to excess air carrying heat out the chimney. If a coal has 10 percent ash and the refuse from the ashpit is 50 percent unburned fuel, a loss of, roughly, 10 percent of the fuel is indicated. Poorly adjusted oil burners may cause a great loss of heat from excess air; this may average 10 to 15 percent. A poorly operating oil burner may not burn more than 90 percent of the fuel, the remainder being unburned and lost.

3. Heat is lost from heating equipment in the basement.

Heat is radiated and carried to the surroundings. Heated air in the basement is likely to find its way into the chimney, especially if the check damper is left open. An open check damper will take air from the basement, which must be replaced by other air. This may come from the rooms above, robbing them of their heat. Such air will come to the basement through an open door at the stairs or through the opening usually found between the bottom of the door and the sill. Such loss may be appreciable. Keep the check damper closed except possibly in very mild weather, when it is difficult to maintain a low fire without opening it. Air needed for burning the fuel should come from air leaks or openings into the basement, preferably near the furnace. A small amount of heat in the basement is usually desirable. During war times it can be at a minimum. The amount of heat radiated from the equipment can be controlled by insulation.

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4. Heat is lost from the house by going into the ground.

It usually is a relatively small amount. How much of this can be prevented depends on the individual case. For most houses little saving along these lines can be accomplished. Insulation can be used where possible.

5. Heat is lost from the house by radiation to surroundings and by being carried away by air.

This is a main heat loss. Its amount depends on how much hotter the house is than the outside temperature. If the temperature inside the house if 72° F. and that outside is 32° F., the difference in temperature is 40°. If the house temperature is lowered to 68°, this difference becomes 36°. It may be roughly calculated that the heat loss becomes 36/40 of what it was, or about 10 percent less. When the house is carried at a lower temperature at night, some heat must be used to raise its temperature back to the day normal, but less heat is lost during the night. Tests have shown a saving of about 5 to 10 percent by allowing the house to cool to 60° at night for the warmer outside temperatures. For the colder outside temperatures, a smaller percentage would be saved. A lower house temperature can be carried with comfort if the air is not allowed to become too dry. This may be prevented by various types of humidifiers. Humidifiers are usually provided with hot-air systems; water-pan devices can be used on radiators. The moisture in the air should not be kept high enough to cause appreciable condensation on windows.

Heat loss from the house can also be reduced by means of insulation[4] and storm doors and windows. If the entire house cannot be insulated, insulating beneath the roof is a very effective and usually a very paying scheme. Savings can sometimes be made by studying the pathways of the heat. For example, a reflecting shield against the wall back of a radiator will prevent too much heat from going directly into the wall.

Heat is not only carried away by air against the sides, windows, and doors of the house, but heat loss also results from cold air from the outside entering the house. To enter, it must drive out the warmer air of the house; it must be heated, so that the desired house temperature is maintained. Such heat loss can be reduced by making the house reasonably airtight; weather-stripping doors and windows and adding storm doors and windows are effective means. The space immediately below the roof should be examined to determine whether there are air leaks at eaves or through ventilators. These should be shut off during the winter.

All outlets to chimneys should be examined for undesirable air leaks. When not in use, fireplaces should be dampered tightly from the chimney; fill in the cracks around the damper if necessary. It is seldom realized how much air can go through a small crack. The inlet air to hot-air systems should come from the inside of the house. As a practical matter, it is doubtful if doing all of these things will result in lack of needed ventilation in the house.

Rooms not absolutely needed should be shut off. If there are water pipes in the walls or water radiators in the room, care must be taken that water in them does not freeze. During the night bedroom doors should be kept closed; in most houses there is a large space beneath the bedroom doors that should be closed with a rug or by other means; the radiators should be shut off; any air registers should be closed tightly, by covering if necessary. The best medical advice appears to be to open bedroom windows only enough for needed ventilation for sleeping.

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4 Powles, Oliver. Home Insulation with Mineral Products: Bureau of Mines Inf. Circ. 7220. 1942.

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The total amount of heat saved by weather stripping, storm doors and windows, and insulation depends on such factors as the type of house, its surroundings, and the severity of the weather. The Bureau of Standards publishes the following table:[5]

Approximate fuel savings in dwelling houses

(Expressed in percentage of fuel that would have been required for similar house without insulation or weather stripping)

	Saving, percent
No insulation, weather-stripped	15 to 20
Same, with double (storm) windows	25 to 30
1/2-inch insulation, not weather-stripped	20 to 30
1/2-inch insulation, weather-stripped	About 40
1/2-inch insulation, with double windows	About 50
1-inch insulation, not weather-stripped	30 to 40
1-inch insulation, weather-stripped	About 50
1-inch insulation, with double windows	About 60

(Expressed in percentage of fuel that would have been required for similar house without insulation but with weather stripping)

With double windows, no insulation	10 to 15
1/2-inch insulation only	25 to 35
1/2-inch insulation, with double windows	40 to 45
1-inch insulation only	35 to 45
1-inch insulation with double windows	50 to 55

5 National Bureau of Standards, Thermal Insulation of Buildings: Circ. 376, table 1, p. 8.

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